IASET: International Journal of Biology,
Biotechnology and Food Science (IASET: IJBBFS)
ISSN(P): Applied; ISSN(E): Applied
Vol. 1, Issue 1, Jan – Jun 2016; 19-26

International Academy of Science,
Engineering and Technology
Connecting Researchers; Nurturing Innovations

MOLECULAR COMPOSITION AND ANTIDIABETIC EFFECT OF *ARTEMISIA HERBA ALBA*

AMINA BESSEDIK

Laboratory for Local Natural Bioressources, Department of Biology, Faculty of Agronomical Sciences

Hassiba Benbouali University of Chlef, Algeria

ABSTRACT

As part of the promotion of medicinal and aromatic plants we consider the essential oil of *Artemisia herba alba* obtained by hydro-distillation.

This work is mainly devoted to the study of quality, safety and efficacy of the essential oil and aqueous extract of *Artemisia herba alba*. It allowed us to show that the extraction of essential oil by hydro-distillation gives a clear fluid and gasoline with a yield of 2% for an extreme period of 3 hours.

The chromatographic analysis allowed us to identify and qualify the essential oil composition which is classified in the α-thuyone chemotype. The analysis of the aqueous extract of *Artemisia herba alba* shows that it has an interesting hypoglycemic effect.

KEYWORDS: *Artemisia Herba Alba*, Antidiabetic Effect, Molecular Composition

INTRODUCTION

The therapeutic properties of plants have been tested for a long time and their valuable characteristics are transmitted from generation to generation.

Algeria has a considerable floristic wealth. This potential of medicinal plants has thousands of species with diverse interests in the food and pharmaceutical field.

The white wormwood (*Artemisia herba alba*) is an hermaphrodite, perennial and spontaneous plant. It is a Mediterranean and Saharo-Indian species (Ozenda 1977). It is very common in North Africa and in the Middle East. It is found in the Moroccan steppe, in the Canary Islands and in south America.

In Algeria, it likes hot, dry climates and form important stands in desert areas (Laghouat, Ghardaia, Bechar,...). It is widespread in the highlands but rare in the northern Sahara.

Artemisia herba alba is used in traditional medicine since ancient times to regulate the menstrual cycle (Fournier, 1948), against intestinal parasites and digestive disorders (Belaïche, 1979). In China and several European countries and in Algeria, it is used externally in the treatment of rheumatism, gout, mouth ulcers, fungal infections and against insect bites and scorpion (Baba Aïssa, 1991). However, it should be used with caution and at lower doses. Indeed, a too high dose can cause very serious fatal poisonings (characterized by hepatorenal nephritis kidney predominantly accompanied by convulsive phenomena) caused by certain ketone compounds, such the α-thuyone, β-thuyone and the camphor (Valnet, 1984).

MATERIALS AND METHODS

- **Botanical Material**

Our study focuses on the plant Artemisia herba alba (essential oil obtained by steam distillation and aqueous extract) collected during the month of December in the pre-Saharan region of Laghouat in Algeria. The geographical location and ecological characteristics of the study station are shown in the table below.

Table 1: Location and Ecological Characteristics of the Study Station

Station	Location	Soil Texture	Latitude	Longitude	Altitude (m)
Laghouat	Central Sahara between Di-Dekia and El Nssafia at 10 km from Laghouat	S-S	33°46'	2°56 E	762

S-S: Slimy Soil

Only the aerial part of the plant is concerned, the clumps or tufts are cut at their base using pruning shears. Sample identification and extraction of *Artemisia herba alba* essential oil (EO) was conducted in the Saïdal group laboratory, Medea, Algeria.

- **Animals**

To verify the safety and efficiency of the oil and aqueous extract of the plant, our in vivo study involved white Wistar rats (20 rats) whose weight is in the range 200g-250g and 95 albino mice (NMRI) whose weight varies between 17g and 23g (USP 35).

- **Preparation of the Aqueous Extract of *Artemisia Herba Alba***

Purpose of the method: extraction of bioactive substances in the aerial part of *Artemisia herba alba*.

Principle: The preparation of the aqueous extract. 10% of the plant is carried out by addition of 10g of powder of the aerial part in 100ml of boiled distilled water, then left for 30 minutes infusion stirring occasionally. The aqueous extract obtained is then centrifuged at 1000 rpm/min for 10 minutes to dispose of plant debris and then filtered through Whatman filter paper type. The filtrate is then placed in small glass vials.

The same principle is used for the aqueous extract of 20% and 5%.

- **Gas-Chromatographic Analysis Coupled with a Mass Spectrophotometer (GC/MS)**

To identify its active ingredient, the essential oil is analyzed on a gas chromatograph Hewlett-Packard 6890N kind Agilant controlled by ChemStation (NIST 98) and equipped with a capillary column (HP5MS) coupled to a mass spectrometer (MS) type Agilant 5973.

Mass Spectrum: Agilent Model 5973

- Temperatures interface (280°C), source (230°C), quadrupole (150°C)
- Ionization energy of 70 eV
- 0.5 gl Injection in split mode 1/50
- Injection temperature 250°C

- HP5MS capillary column (30m x 0.25 mm x 0.25 µ m)
- Temperature programming: 50°C for 0 min, 4°C / min to 250°C for 30 min
- Flow of carrier gas: helium (1 ml / min)
- Temperatures interface (280°C), strains (230°C), quadrupole (150°C).

Identification of components: The various constituents of the essential oil are identified by comparing their mass spectra with those of the compounds of WILLET and NIRST98 databases. The identification of the molecules is confirmed by comparison of their retention indices with those known in the literature (Adams 2001).

- **Evaluation of the Hypoglycemic Effect of *Artemisia Herba Alba* (in vivo)**

Purpose of the Method: Demonstration of the hypoglycemic effect of aqueous extract of *Artemisia herba alba* on rats made diabetic by alloxan (Rahman et al, 2005).

Principle: Induction of type I diabetes (IDDM) by alloxan injection subcutaneously in different groups of rats. Injection of decreasing doses of aqueous extract of *Artemisia herba alba*, followed by regular monitoring of blood glucose.

In our experiment, we consider 20 rats weighing between 200 and 250g divided into 4 similar lots. Subsequently, we inject a dose of 150 mg/kg of alloxane to different batch subcutaneously. From the 3rd day of injection, an assessment of blood glucose is performed (a higher glucose 2 g/l is considered diabetic condition).

After a week we administrate orally to each of the lots, the physiological water, glucophage and various doses of the aqueous extract for 3 weeks except weekends. The distribution of the lots is shown in the table below.

Table 2: Experimental Conditions of the Antidiabetic Effect of Different Batches

Lot	Products	Doses	Administred Dose (3 Times Per Day)	Way of Administration	Average Weight (g)
01	Physiological water		1 ml	Oral	218
02	Glucophage	3.3 mg/ml			225
03	Aqueous extract of *Artemisia herba alba*	100 mg/ml			232
04	Aqueous extract of *Artemisia herba alba*	200 mg/ml			220

RESULTS AND DISCUSSIONS

GC/MS Analysis of the Essential Oil of *Artemisia Herba Alba*

The GC /MS analysis of the essential oil of *Artemisia herba alba* in the region of Laghouat reveals the presence of 23 volatile compounds. Only 17 of them have been identified.

The combination of volatile compounds of this species is variable, in terms of diversity and concentration. The essential oil of *Artemisia herba alba* comprises terpene esters with terpinyl acetate, terpene alcohols such as α-terpineol and monoterpenes such as camphene. There are also oxides such as 1,8 cineol.

The classification of the identified components based on functional groups shows the dominance of camphor in *A.*

herba alba, whose distribution is relatively high (41%), followed by α-thujone (31.9%), 1,8-cineole (5%), and Chrysanthénone (5%). They are accompanied by other minor constituents such as Camphene (4.3%), the α-Terpineol (2%), the Santonil (1.9%), alcohol Artemisia, the thuyanol (1.7%), Acetate bornyl acetate and terpenyl (0.6%)...

The essential oil of *Artemisia herba alba* is similar in chemical composition to *mesatlantica Artemisia* (Asteraceae) except for the chrysanthenone, which is absent in the latter.

The essential oil of *Artemisia herba alba* is known by its composition in monoterpenoids, especially oxygenates, such as 1,8 cineole, chrysanthenone, chrysanthenol, α / β thuyone, camphor and davanon as major components (Lawrence, 1971; Lawrence, 1976 ; Ghanmi, 2012). The chrysanthenone is thus a major constituent (47.71%) in most sagebrush. This difference in chemical composition can be an indicator to differentiate two closely related species that abound at the same altitude.

Table 3: Chemical Composition by GC / MS of the Essential Oil of the Aerial Parts of Artemisia Herba Alba

Station: Laghouat			
Identified (IC) and Non-Identified (NIC) Compounds		**Retention Time**	**Composition (%)**
α-pineme	1	5.22	0.12
Camphene	2	5.50	4.3
NIC	3	-	-
β-pineme	4	6.12	0.23
P-cymene	5	7.15	0.21
Cineole 1,8	6	7.23	5
Santonila alcohol	7	7.73	1.9
Artemisia alcohol	8	8.75	1.7
α–Thyuone	9	9.07	31.9
β–Thyuone	10	9.63	5
Chrysantenone	11	9.87	5
Camphor	12	10.62	41
NIC	13	10.74	0.1
Borneol	14	11.62	0.2
Thyuanol	16	11.89	1.7
α–Terpineol	17	12.18	2
Chrysantenile acetate	19	15.72	0.25
Bornyle acetate	20	16.83	0.6
Terpenyle acetate	22	18.92	0.6
NIC	23	-	-

The chemical polymorphism, especially in Artemisia, particularly characterizes the Asteraceae family. This variation or chemo-variety can exist in different populations and may be due to external factors such as sunlight, nature and components of the soil, temperature, and altitude as well as internal factors such as the genetic heritage of individuals. These factors are all parameters that affect both yield and chemical quality of the essential oil.

From a quantitative point of view, the content of ketones (α thuyone + camphor) is very important in Laghouat station. The concept of chemotype was introduced to distinguish between genetically different individuals within the same species, using the major constituents. By taking the proportions of ketones, we can classify this essential oil of Laghouat in chemotype α thuyone + camphor. This chemotype has already been highlighted by Benjilali et al. (1982).

Hypoglycemic Effect of the Aqueous Extract

One week after the rats of lots 01, 02, 03 and 04 are rendered diabetic by injection of 150 mg/kg of alloxan (and hence hyperglycemia ranging from 1.42 ± 0.16 g / l to 3.08 ± 0.22 g / l), we gave the rats 3 times a day with physiological water and doses of glucophage (D = 3.3mg / ml) and aqueous extract of *Artemisia herba alba* in different concentrations (D1 = 100mg / ml, D2 = 200mg / ml).

The rats are monitored weekly (for 1 month) by blood sampling at the end of the queue for the measurement of blood glucose.

The results are illustrated in Figure 1 below.

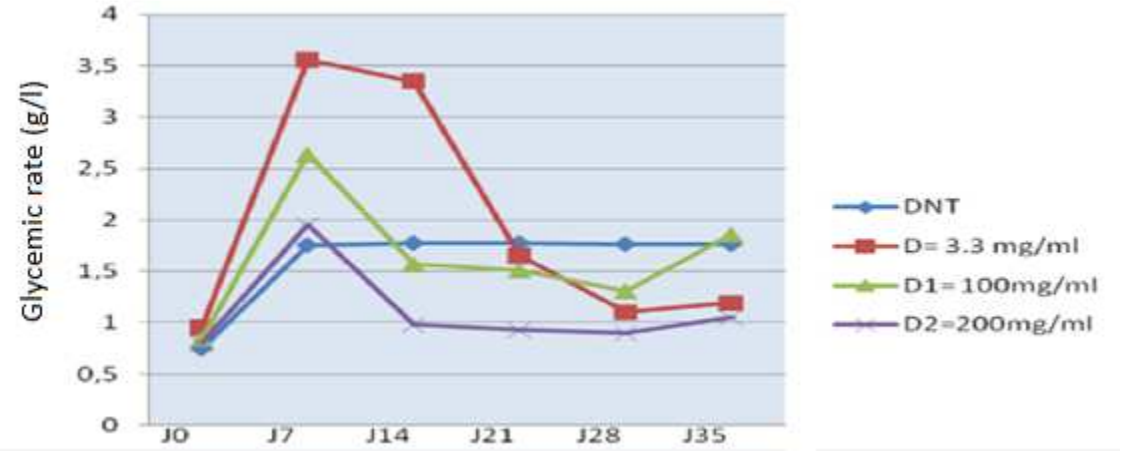

Figure 1: Glycemic Rate from the 1st to the 35nd Day of the Treated Groups by Glucophage and the Aqueous Extract of *Artemisia Herba Alba*

J0: Injection of alloxane through subcutaneously at a rate of 150 mg/kg. **J7:** First day of gavage. **J28:** First day of treatment discontinuation.	**DNT:** Untreated diabetic. **D:** Dose of glucophage (3.3 mg/ml) **D1 and D2:** Doses of *A. herba alba*.

Following the first dose of treatment, blood glucose levels in diabetic rats significantly decreased compared to controls.

Hyperglycemia of batch 3 treated is reduced by 2.64 to 1.57 g / l, that of lot 4 treated is reduced by 1.95 to 0.98 g / L at day 14.

These rates persist for the next two weeks and then decrease for lots 03 and 04 to 28 days (gavage stop by D1 and D2).

Beyond 28 days, blood glucose begins to rise and glycosuria reappears: it is the diabetic state.

Another 7 days after administration of glucophage (D = 3.3mg / l) to diabetic rats of lot 02 (3.56 g / l), it was observed an increase in blood glucose. Hyperglycemia of lot 02 increases by 3.56 to 3.65 g / l. After this time there was a significant decrease in blood sugar of 3.65 to 1.1 g / l. This rate increased slightly to 35th day after stopping treatment.

This shows that the effect of *Artemisia herba alba* rapidly decreases blood glucose levels compared to that of glucophage in early treatment.

In this study, we found that the aqueous extract of *Artemisia herba alba* plays a crucial role in lowering serum glucose or by stimulating the secretion of insulin, or by an extra-pancreatic action and then by the effect of glucose uptake and utilization by the various tissues.

The results obtained in this study show that administration of aqueous extract of *Artemisia herba alba* to diabetic rats significantly decreases the serum concentration in glucose for single-dose D1 and high dose D2, after the third week of treatment.

These results confirm the initial findings (Al shamaony et al., 1994) that the administration of aqueous extract of *Artemisia herba alba* respectively at a dose of 250 mg / kg and 390 mg / kg significantly decreases the blood sugar right after- three weeks of treatment.

The first thought that may come to mind is that the aqueous extract of *Artemisia herba alba* acts in the same way as some oral agents such as glibenclamide by the closure of K + / ATP channels, the membrane depolarization and stimulation of Ca2 + influx, which are the first key steps in insulin secretion (Pari and Latha, 2005).

Another possible mechanism for the action of the aqueous extract of *Artemisia herba alba* which may be provided by the liver, by influencing the gluconeogenesis or glycogenolysis. Some flavonoids that have been isolated from plants, inhibit glucose transporting molecules in the intestine decrease the expression of genes that control gluconeogenesis increase the

Storage of glucose in the liver and reduce the breakdown of glycogen (Shmizu et all, 2000; Waltner-Law et all., 2002; 2004; Sarkhail et all., 2007).

CONCLUSIONS

The present work is mainly devoted to the study of quality, safety and efficacy of the essential oil and aqueous extract of *Artemisia herba alba*. Its outcomes can be summarized as follows.

First, the extract the essential oil by hydro distillation, gave us a clear fluid and gasoline with a yield of 2% for a period of 3 hours.

The chromatographic analysis allowed us to identify and qualify the essential composition of our oil which is classified in the chemotype: Thyuone α-camphor.

The study of the chemical composition shows that the essential oil of *Artemisia herba alba* has a wide variety of components. It is rich in esters and terpene alcohols. The major compound is camphor.

Artemisia herba alba aqueous extract has interesting hypoglycemic properties.

REFERENCES

1. Shamaony L., Al KhazRaji M. S., Twaij H. A. (1994). Hypoglycemic effects of Artemisia herba alba.Il. Effect of a valuable extract on some blood parameters in diabetic animals. *J Ethnopharmacol, 43(3)/167-171*.
2. Baba Aissa F. (1999). Encyclopédie des plantes utiles. Flore d'Algérie et du Maghreb. Edition: Librairie moderne. Rouiba, Algérie, p 86.
3. Bailey C. J, Day C. (1989). Traditional plants medicines as treatments for diabetes. Diabetes Care, 12(8):553-564.

4. Belaïche P., (1979). Traité de phytothérapie et d`aromathérapie. Ed. L Maloine; Paris Tome I. P 100-123.
5. Benjilali B., Sarris J. et Richard H. (1982).Nouveaux chémotypes d'*Artemisia herba-alba*. Sci Aliments, 2:515–527.
6. Fournier P. V. (1948). Plantes médicinales et vénéneuses de France. Ed. Lechevalier, Paris. Tome I, p 63-90.
7. Ghanmi M., Satrani B., Aafi A., Isamili M.R., Houti H., El Monfalouti H. et Bencheqroun K.H., (2012). Activité antimicrobienne des huiles essentielles d'*Artemisia mesatlantica*, plante mésedémique du Maroc. Bulletin de la société royale des sciences de Liège, 81: 421.
8. Huang D.J., Lin C.D., Chen H.J. and Lin Y.H. (2004). Antioxidant and anti proliferative activities of sweet potato constituents, Bot. Bull. Acad. Sim45: 179-186.
9. Lawrence B.M. (1971). Techniques used in essential oil analysis.J. Can. Inst Food Technol. 4: 44-48.
10. Lawrence B.M. (1976). Progress in Essential oils. Flav. and Fragr., 1: 11-13.
11. Marrif H. I., Hassan K. M. (1995). Some pharmacological studies on Artemisia herba alba (Asso). In eabbits and mince. J Ethnopharmacol, 49(1):51-55.
12. Ozenda P. (1977). Flore du Sahara. Edition CNRS, Paris-France.
13. Pari L., Latha M. (2005). Antidiabitic effect of Scoparia dulcis: effect on lipid peroxidarion in streptozotocin diabetes. G en physiol Biol Chem 177-196.
14. Rahman S.M., Dobrzyn A., Lee S.H., Dobrzyn P., Miyazaki M. and Ntambi J.M. (2005). Stearoyl-CoA desaturase 1 deficiency increases insulin signaling and glycogen accumulation in brown adipose tissue. Am. J. Physiol. Endocrin Metab. 288(2): E381-7.
15. Ravi K. Rajase, Karan SSubramanian S. (2005). Antihyperlipidemoc effect of Egenia jambolana seed Kernel on streptozotosin-induced diabets in rats. Food and chemical toxicology,43:1433-1439.
16. Saleh N. A. M., EL-Negoumy S. I., Abd-Alla M. F., Abou-Zaid M. M., Dellamonica G., Chopin J. (1985). Flavonoid glycosides of Artemisia monosperma and A. herba alba. Phytochemistry, 26:30-3064.
17. Sarkhail P., Rahmanipour S., Fadyvatan S., Mohammadirad A., Dehghan G., Amin G., Shafiee A., Abodollahi M. (2007). Antidiabitia effect of phlomis anisodonta: effects on hepatic cells lipid peroxidation and antioxidant enzumes in exprimental diabetes. pharmacological Reasearch,56:261-266.
18. Shirwaikair A., Rajendran K., Dinesh Kumar C., Bodla R. (2004). Antidiabitic activity of aqueous leaf extracts of annona squamosa in streptozotocin-nicotinamide type 2 diabetic rats. Journal of ethnopharmacology,91:171-175.
19. Shmizu M., Kobayashi Y., Suzuki M., Stsu H., Miyamoto (2000). Regulation of intestinal glucose transport by tea catechins. Biofactors,13:61-65.
20. Shmizu M., Kobayashi Y., Suzuki M., Stsu H., Zhang X. F., Tan B. K. (2000). Antihyperglycaemic and ant-oxidant properties of andrographis paniculata in normal and diabetic rats. Clin Exp Pharmacol Physiol, 27:358-363.

21. Valnet J. (2005). L'aromathérapie. Ed. Maloine. Paris. 640p.

22. Zouari S., Zouari N., Fakhfakh N., Bougatef A., Ayadi M.A., Neffati M. (2010). Chemical composition and biological activities of a new essential oil chemotype of Tunisian *Artemisia herba alba* Asso. Journal of medicinal plants research 10: 871-880.